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SEISMIC ACTIVITY OF MOUNT EREBUS IN 1984–1985

Katsutada KAMINUMA¹, Jun AMINO² and Satoshi MIURA³

¹*National Institute of Polar Research, 9–10, Kaga 1-chome, Itabashi-ku, Tokyo 173*

²*Faculty of Science, Toyama University, Gofuku, Toyama 930*

³*Faculty of Science, Tohoku University, Aramaki Aoba, Sendai 980*

Abstract: A program to monitor the seismic activity of Erebus Volcano in Antarctica started in December 1980 as an international cooperative program among Japan, the United States and New Zealand. A new volcanic episode began on 13 September 1984 and continued until December.

The seismic activity of Mount Erebus in 1985 was discussed and the following results were obtained: 1) A remarkable decrease of the background seismicity was recognized after the September 1984 activity. 2) The average number of earthquakes in 1985 was 23 events per day with only one earthquake swarm in July. 3) The earthquake locations in 1985 clustered near the summit.

1. Introduction

Mount Erebus (3794 m), located on Ross Island at 77°37'S, 167°09'E is the only active volcano in the Antarctic at present. A program to continuously monitor the seismic activity of Mount Erebus and to identify its mechanism of eruptions has been carried on since December 1980 as an international cooperative program among Japan, the United States and New Zealand, called the "International Mount Erebus Seismic Study (IMESS)" (KIENLE *et al.*, 1981; TAKANAMI *et al.*, 1983a, b).

The background seismicity of the Mount Erebus area in 1982–1984 was made clear by the IMESS observations as follows: 1) The average numbers of earthquakes in 1982, 1983 and January–August 1984 were 64, 134 and 146 events per day. 2) The earthquakes were located mainly in the Mount Erebus area, and some were in the surrounding areas. 3) Several earthquake swarms occurred every year.

A new volcanic activity began on 13 September 1984 and continued until December (KIENLE *et al.*, 1981, 1982; TAKANAMI *et al.*, 1983a, b; SHIBUYA *et al.*, 1983; UEKI *et al.*, 1984; KAMINUMA *et al.*, 1986). As shown in Fig. 1, ten seismic stations were operated in 1984–1985. The seismic stations on Ross Island were linked by radio-telemetry to Scott Base of New Zealand at 77°51'03"S, 166°45'45"E, 38 km south of the Erebus Summit. All seismic signals were recorded on magnetic tapes of a 14-channel FM data recorder and on a long term recorder at Scott Base. The seismicity of Mount Erebus after the new activity until December 1985, is discussed in this paper.

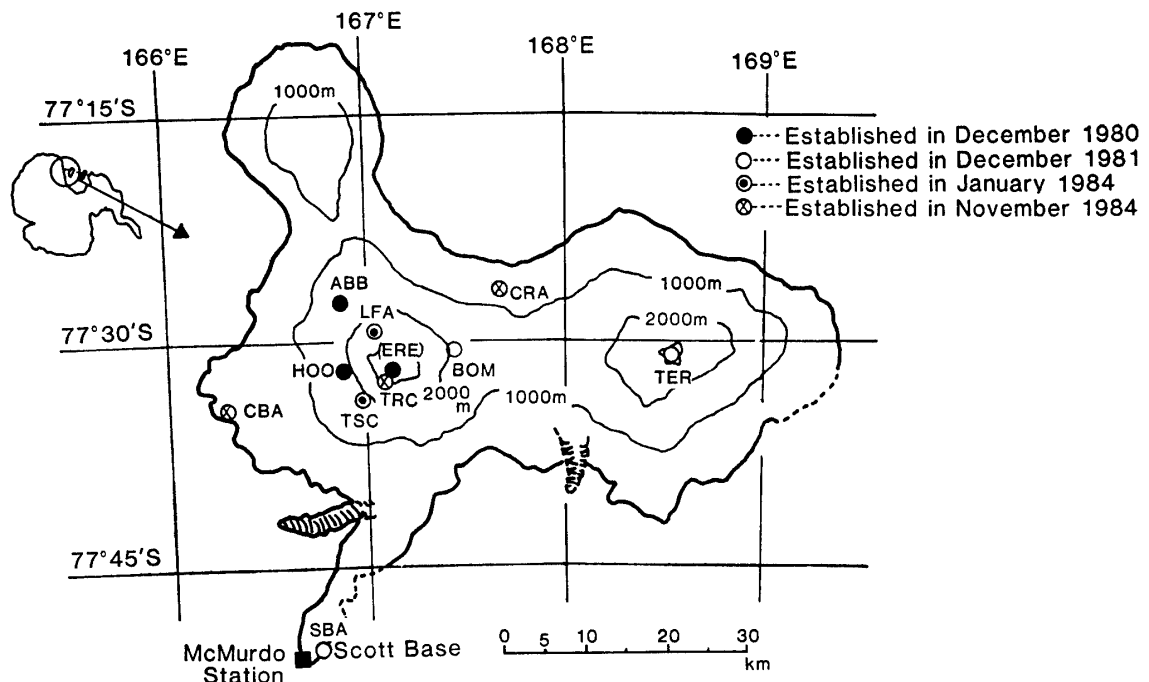


Fig. 1. The configuration of the radio-telemetered IMESS seismic network on Ross Island. The abbreviations of the stations are as follows: Abbott Peak (ABB), The Erebus Summit (ERE; operated until 13 September 1984), Hoopers Shoulder (HOO), Bomb (BOM), Mount Terror (TER), Lower Fang (LFA), Three Sisters Cone (TSC), Truncated Cone (TRC), Cape Barne (CBA), Crash Site (CRA) and Scott Base (SBA).

2. Daily Frequency of Earthquakes

The daily earthquake counts at Hooper Shoulder Station in 1982–1984 (HOO in Fig. 1) are given in Fig. 2. Only the events which occurred around Mount Erebus were counted and illustrated in Fig. 2. Teleseisms and local earthquakes which were easily estimated from their wave forms to occur outside Ross Island were not counted. The theoretical earth tide around Mount Erebus is also shown in Fig. 2.

As denoted by “no rec.” in Fig. 2, operations at all stations of the network were interrupted during the austral winter because solar panels were used to supply power until the end of 1984. However, some more batteries were installed at HOO in December 1984, and HOO remained operational throughout the winter of 1985.

Symbols 82-A, 83-B, 84-C, etc. in Fig. 2 denote the earthquake swarms, which were defined by KAMINUMA *et al.* (1985). Sixteen earthquake swarms were detected during the 30 month period in 1982–1984 (KAMINUMA *et al.*, 1986). The swarms frequently occurred in March, April and July of each year.

The new volcanic eruptive activity started at 0508 (UT) on 13 September 1984 with a number of large explosions. Some earthquakes and/or volcanic tremor were felt at McMurdo Station and Scott Base, about 40 km south of the Erebus Summit. These felt shocks were the first ones recorded in the McMurdo Sound area. The volcanic activity lasted until the end of December 1984. The number of earthquakes quickly decreased to less than 20 events per day (KAMINUMA, 1987).

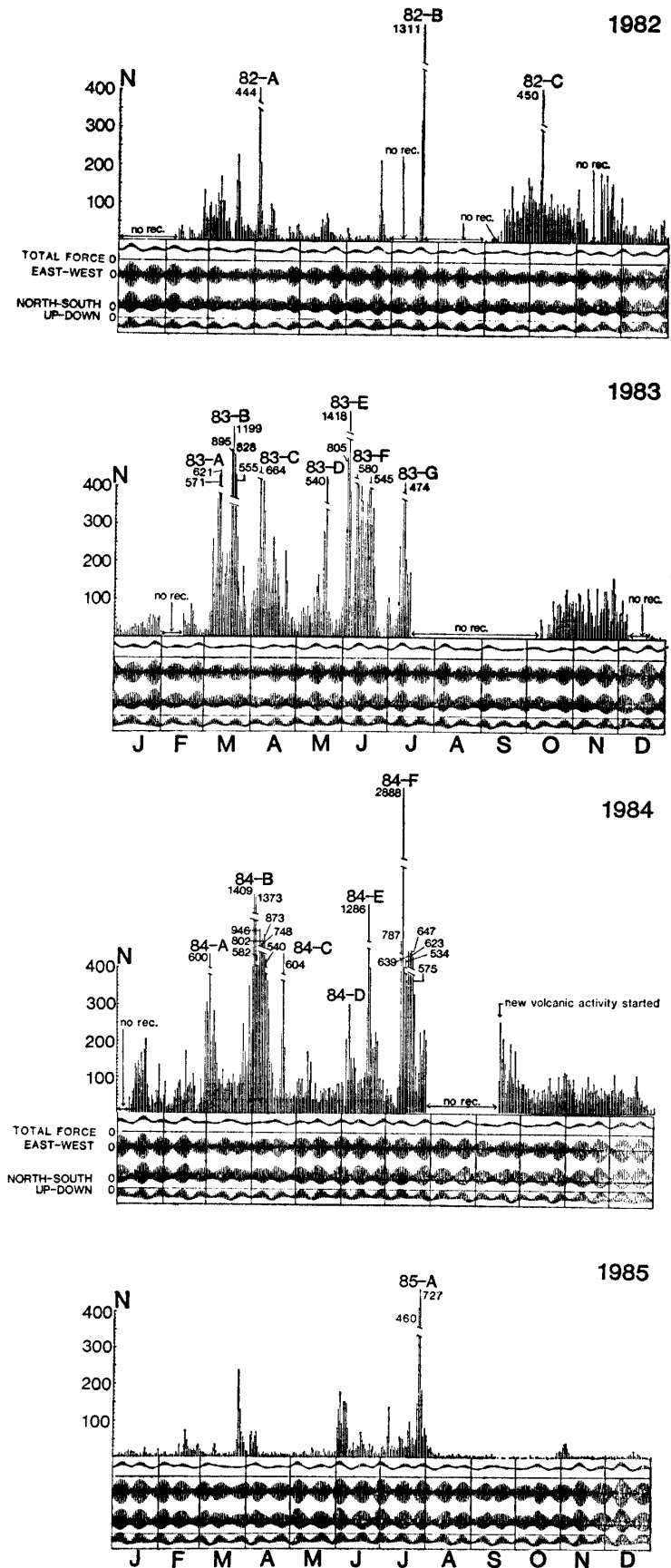


Fig. 2. Daily number of earthquakes counted at Hoopers Shoulder Station (HOO in Fig. 1) in 1982, 1983, 1984 and 1985. 82-A, -B, etc., denote the earthquake swarms.

A distinct decrease of seismicity in 1985 is recognized in Fig. 2. Twenty-three earthquakes per day were recorded and only one earthquake swarm, as shown by 85-A in Fig. 2, occurred in July. The activity was very low since August 1985. Only a few earthquakes per day and no earthquake swarms were recorded during the last five months in 1985.

3. Earthquake Locations

The hypocenter locations of earthquakes in 1985 are shown in Fig. 3. The focal depth distribution in Fig. 3 is projected onto a vertical cross section oriented SW-NE. Locations of 109 events were determined with the errors less than 1.0 km in both horizontal and vertical directions, and their O-C (the arrival time of observed initial *P* phase minus that of the calculated one) residual was less than 0.5 s. The large number of stations (ten stations) operating in 1985 made it possible to locate most of the events.

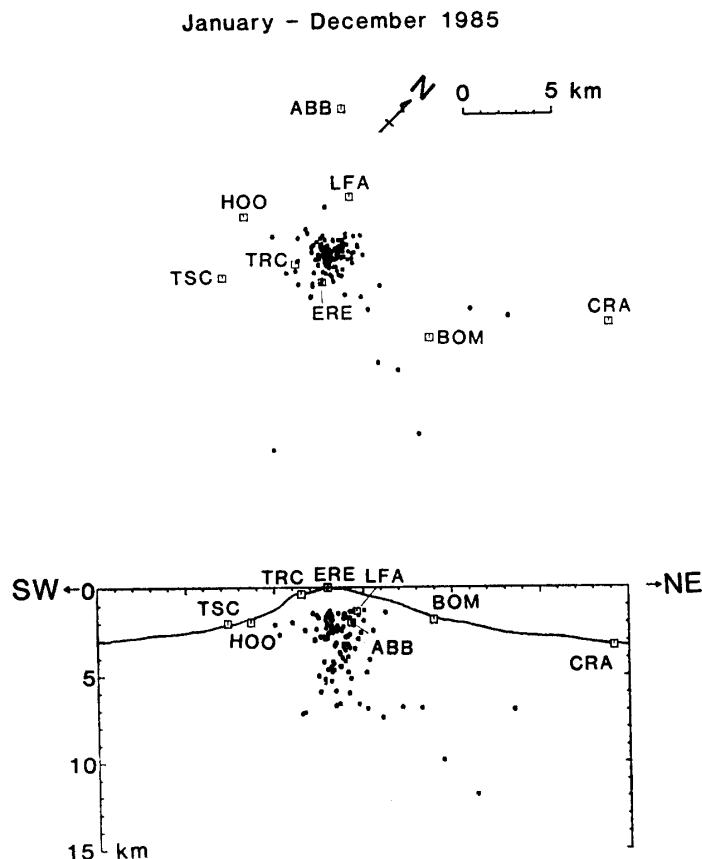


Fig. 3. The hypocenter distribution of earthquakes in 1985. The focal depth distribution (lower part) is projected onto a vertical NE-SW section.

Before September 1984, many earthquakes were located outside the mountain area as reported by the previous papers (KIENTLE *et al.*, 1981, 1982; TAKANAMI, 1983a, b; KAMINUMA *et al.*, 1986; UEKI *et al.*, 1984; KAMINUMA, 1987). As shown in Fig. 3, however, almost all earthquakes in 1985 clustered near the summit; within the circle

of 5 km diameter, at depths from 2 to 8 km. Very few earthquakes were located outside the mountain area. A distinct difference is recognized between the earthquake locations before and after the September 1984 eruptions.

4. Conclusion

A new volcanic episode began on 13 September 1984 and continued until December. The seismicity in 1985 was very low in comparison with those of the previous three years before the new volcanic episode. The seismic activity in and around Mount Erebus in 1985 was as follows:

- 1) A remarkable decrease of the background seismicity was recognized after the September 1984 activity.
- 2) The average number of earthquakes in 1985 was 23 events per day with only one earthquake swarm in July.
- 3) The earthquake locations in 1985 clustered near the summit.

Acknowledgments

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